

# The National Geographic Magazine

AN ILLUSTRATED MONTHLY



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THE ENCHANTED MECA—THE GREAT SOUTHWESTERN CLIFF AND TENT CAMP

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## THE ENCHANTED MESA

By F. W. HODGE,

*Bureau of American Ethnology*

The pueblo of Azuma, in western central New Mexico, is the oldest settlement within the limits of our domain. Many of the walls that still stand on that beetling pedestal were seen by Coronado during his marvelous journey in 1540, and even then they were centuries old.

The valley of Azuma has been described as "the Garden of the Gods multiplied by ten, and with ten equal but other wonders thrown in; plus a human interest, an archeological value, an atmosphere of romance and mystery;" and the comparison has not been overdrawn. Stretching away for miles lies a beautiful level plain clothed in grama and bound on every side by mesas of variegated sandstone rising precipitously from 300 to 400 feet, and relieved by minarets and pinnacles and domes and many other features of nature's architecture. About their bases miniature forests of piñon and cedar are found, pruned of their dead limbs by native wood-gatherers. Northwestward, Mount Taylor, the loftiest peak in New Mexico, rears its verdant head, and 20 miles away to the westward the great frowning pine-fringed Mesa Prieta, with the beautiful vale of Cebollita at its feet, forms a fitting foreground to every dying sun.

But none of these great rock-tables is so precipitous, so awe-inspiring, and seemingly so out of place as the majestic isolated Kataímo or Enchanted Mesa, which rises 430 feet from the middle of the plain as if too proud to keep company with its fellows; and this was one of the many wonderful homesites of the

Acoma during their wanderings from the mystic Shijapu in the far north to their present lofty dwelling place.

Native tradition, as distinguished from myth, when uninfluenced by Caucasian contact, may usually be relied on even to the extent of disproving or verifying that which purports to be historical testimony. The Acoma Indians have handed down from shaman to novice, from father to son, in true prescriptive fashion for many generations, the story that Katzino was once the home of their ancestors, but during a great convulsion of nature, at a time when most of the inhabitants were at work in their fields below, an immense rocky mass became freed from the friable wall of the cliff, destroying the only trail to the summit and leaving a few old women to perish on the inaccessible height. What more, then, could be necessary to enwrap the place forever after in the mystery of enchantment?

This tradition was recorded in its native purity some twelve years ago by Mr Charles F. Lummis, who has done so much to stimulate popular interest in this most interesting corner of our country, and the same story was repeated by Acoma lips to the present writer while conducting a reconnaissance of the pueblos in the autumn of 1895. During this visit, desiring to test the verity of the tradition, a trip was made to the base of Katzino, where a careful examination of the talus (especially where it is piled high about the foot of the great southwestern cleft (Pl. 32, 34) up which the ancient pathway was reputed to have wound its course) was rewarded by the finding of numerous fragments of pottery of very ancient type, some of which were decorated in a vitreous glaze, an art now lost to Pueblo potters. The talus at this point rises to a height of 224 feet above the plain, and therefore slightly more than half-way up the mesa side. It is composed largely of earth, which could have been deposited there in no other way whatsoever than by washing from the summit during periods of storm through many centuries. An examination of the trail to a point within 60 feet of the top exhibited traces of what were evidently the hand and foot holes that had once aided in the ascent of the ancient trail, as at Acoma today. Even then the indications of the former occupancy of the Enchanted Mesa were regarded as sufficient and that another one of many native traditions had been verified by archeologic proof.

Enchanted Mesa has become celebrated during the last summer through the reports of the expedition of Prof. William Libbey, of Princeton, who, after several days of effort, succeeded in scal-





THE GREAT SANDSTONE CLEFT OF THE MESA

Through this cleft the traditional trail passed, and cleared traces of it are to be seen on each side of the vertical Scar in the right of the upper ladder.





ing the height, in the latter part of July, by means of a life-saving equipment. It would seem that Professor Libbey neglected to search for relics in the talus, that he devoted no attention to the great southwestern cleft or cove up which the trail was reputed to have passed, and that after spending some three hours on the narrow southern extension of the mesa top, awaiting the arrival of a ladder from Acoma to conduct him across a fissure, he employed the remaining two hours in a reconnaissance of the wider and more interesting part of the height, finding nothing that would indicate even a former visit by human beings.\*

While engaged in archeologic work in Arizona and later in Cebolita valley in western central New Mexico, some 20 miles westward from Acoma pueblo, I was directed to visit Kaizimo once more in order to determine what additional data of an archeological nature might be gathered by an examination of the summit. The knowledge gained by the previous visit made it apparent that a light equipment only would be necessary to accomplish the task. Procuring an extension ladder, comprising six 6-foot sections, some 300 feet of half-inch rope, and a pole-pick, together with a number of bolts, drills, etc., which afterward were found to be needless, I proceeded to Laguna, the newest, yet the most rapidly decaying, of all the pueblos, on the Santa Fé Pacific railroad. Here I was fortunate in enlisting the services of Major George H. Pradt, who has served as a United States deputy surveyor in that section for nearly 30 years; Mr A. C. Vroman, of Pasadena, California, a few of whose excellent photographs are here reproduced, and Mr H. C. Hayt, of Chicago. Much of the success of the little expedition is due to the untiring aid of these gentlemen, and for many creature comforts I am indebted to the Messrs Marmon, whose beautiful little home at Laguna has delighted the heart of many a weary wayfarer in that sunny land.

Leaving the railroad September 1, we proceeded with two farm wagons, each drawn by a very small black mule and a large white horse, driven by two sturdy Laguna boys. The road trends westward for about seven miles, then turns southward through a rather wide valley scarred with arroyos and lined with

\* Had the explorer crossed to the northern part of the mesa by means of a bunch a few feet below the summit of the rocky southern tongue, it would not have been necessary for him to spend most of his time so fruitlessly in awaiting the arrival of timber to cross the fissure. The ladder was found as Professor Libbey had left it, but was taken down by one of the Indians, who followed the bunch mentioned, in order to measure the rope for his own use. The ladder is the exact one shown in Pl. III, the photographs having been made during the descent.

fantastically curved sandstone cliffs. The summit of Mesa Encantada is visible for several miles ere the vale of Acoma is reached, and as one enters the valley proper he cannot fail to appreciate the wisdom displayed by the natives in the selection of the beautiful, grassy, mesa-dotted plain that has been their home for so many generations.

The next day was spent in the village witnessing that curious anomaly of paganism intermixed with christianity, known as the *Fiesta de San Estevan*. On the morning of the 3d an early start was made for Mesa Encantada, which lies three miles north-eastward from the pueblo, just within the eastern boundary of the Acoma grant, in latitude  $34^{\circ} 54'$  N., longitude  $107^{\circ} 34'$  W.

The remainder of the forenoon was employed in making camp in the little grove of cedars at the base of the cleft near the south-western corner of the height, in unpacking apparatus, and in determining the altitude of the mesa above the western plain. The observations of Major Pratt show that the elevation of the foot of the great talus slope above the plain is at this point 33 feet, the apex of the talus 224 feet above the plain, and the top of the highest pinnacle on the summit of the mesa overlooking the cleft 431 feet\* above the same datum. (Pl. 32.)

The start from camp was made at noon. The ascent of the talus, in which the potsherds had been observed in such considerable quantities two years previously, was made in a few minutes, the ladders, ropes, and photographic and surveying instruments being carried with some effort, since climbing, heavily laden, at an altitude of 6,000 feet, in a broiling sun, is no trifling labor; but the real work began when the beginning of the rocky slope of the cleft was reached. One member of the party, taking the lead, dragged the end of a rope to a convenient landing place, where a dwarf piñon finds sufficient nourishment from the storm-water and sand from above to eke out a precarious existence. Fastening the rope to the tree, the outfit was hauled up, and the other members of the party found a ready means of ascent. The next landing was several feet above, at the base of a rather steep pitch of about twelve feet. This wall, although somewhat difficult to scale, may be climbed with greater or less safety by the aid of several small holes in its face. These holes were doubtless made artificially, but as the narrow pathway at this point is now a drain-

\* These elevations were determined trigonometrically by means of an engineer's transit, using a base-line of 100 feet measured opposite the cleft, the observations from the northern end of the line giving 431 feet and from the southern end 425 feet; mean, 428 feet.

apron was during the period of the storm, the softest ice and snow were removed, revealing that, as yet, the glacier really kept its former shape. The old ice in this place was readily seen, marked with the aid of two sections of the latter, a rope being carried over the old peak as I escaped to a large boulder in the corner of a crevasse, because some 60 feet below the surface.

This was the point which I reached during the 1905 visit. At that time I spent several minutes on this ledge, looking down at



11

from my hole. This does not signify that none is exposed, for each here and elsewhere also is the old ice piled blocks of stone have blown away so recently that their edges have not yet had time to round by erosion, and the now exposed faces of their former abiding places on the cliff wall are yet unretained by weathering. (See Fig. 1.)

The boulder previously alluded to rests in a corner of the ter-

I went round her viewing the clausin while seated on it. I found

of four oak sticks, lying beside the boulder, that I am sure were not there during my previous climb. They were about 2½ feet in length, an inch thick, and had been freshly pointed at each end with a sharp tool, evidently a hatchet. Their occurrence here

are now visible only on close examination. No shadow, indeed, but

sticks afforded an indication of the former use of the holes, it

was a means of sealing the well in modern times. I therefore concluded that the sticks had recently been left there by one who

few moments later Mr Hayt dug from the loose sand at the

difference in aspect and texture. As this difference is far greater than between modern Acquia and Zañ wari, for example, and

view

before us. Detecting the middle of the eastern face of the cave as the most convenient and least hazardous point of ascent, the

it reached the lower part of the sloping terrace above. Two





able; yet I swayed and creaked and heaved like a tree, until the rope was stretched, and I reached no little cure to step from my

from a necessary bearing. The shelf was gained in safety, however; the rope was tied as a ring and made fast around a large block of stone on the terrace to the left. The stone was secured and by one end, while the rope lay around his chest and under his armpits, by the lower as a measure of protection. Then the rope, made of twisted hide, was fastened to the end of a pole driven to the two Indians below and drawn up piece by

The time consumed by the entire party was somewhat over two hours.

If the view from the valley at Acoma is beautiful, that from the summit of Hualfing is sublime. Mesa Prieta was still in

the gloom beyond. March the grand, bare of the storm the

of it is that fashioned the northern horizon.

The summit of Hualfing has been swept and carved and swept again by the winds and rains of centuries since the ancient

The walls of the dwellings, undoubtedly of the sun-dried mud-brick that stretched across the mesa, must have been erected on the soil of the mesa, for the native Indians are still when they have it, a lot

The day before was a day of storm, a great rain and

at a few "pavement" around the sandstone. The water had

If the storm is as strong as the storm and about the same as in every storm for several days.

There is little wonder then, that I hesitated of it. I am even



a single pole when we had reached the top of the tree I had a hard climb but the observations were great, and yet we had been on the summit only a few minutes when Major Hume found a shelter of

1. Examine the document and write the top & bottom to check the document & write the date.

1. The first step is to identify the problem. In this case, the problem is that the system is not working properly.



ex- reason the reason that it may have found its origin there -  
it seems to me as I think it will appear to some one  
who will examine the accompanying illustrations, fig 7, that  
only a great natural agency like a tidal wave could have  
erected such a pile could not have been erected save by the hand of man.  
The great question is why it is there if an earthquake

1. The research is a qualitative study of a phenomenon that is not fully understood.

It would have been impossible  
to get the copy right the way you did it

THE LOST LADY OF THE MOUNTAINS

The novel in essence of the eastern and western was contained in both word and of the western color growth work, but no color or outlines of a regional occupancy were observed. The same was

we were compelled to suspend the investigation in order to make preparation for our night's stop. After a brief rest, Mr. Krumpholtz and Mr. H. returned to the office in the evening.

our historical database is very old (i.e., the process is in 2010), and the other is about our work as a of our language as now. After a heavy breakfast, we immediately began a survey of the res-



these Indians among us. They were scarcely friendly at first, indeed, according to the story of our two Indians who had spent the night in the camp below, they had seen our fire and had come with the avowed intention of compelling us to descend, even if they had to threaten to run down our ladder. A little explanation, however, coupled with the information that we kept our fire well under sugar in a crevice beyond the camp fire,

10. 11. 2017

† The  $\log_{10}$  of the mean of the  $\log_{10}$  values was used to calculate the geometric mean.

tribe and a medicine priest, Lalla Pito and Sar Lago Savath, pronounced. After careful inquiry in regard to the location of the former occupancy of Kalama, Lalla Pito informed us that "the natives" had lived there so long ago and the stumps in the country were so decayed, so that we could scarcely expect to find any remains on the surface of the mesa. When we told him

of the other evidences of the lofty habitation of the Kanakas on

of the present Acornus to the mesa top. They evinced much curiosity in the place, and were greatly surprised when we took

factory examination. It is needless to say that the natives did not indicate that the pole was intended to be used in any way.

of ancient pottery up to similar to the shape picked up the

end of a white stone ax, on the edge of which several small

to me. After descending the mesa the same Indian exhibited

one, which was neither similar to the other. He had found it on the summit or rather on a ledge a few feet below the summit

, the unexposed surface being stained brown in contact with the ash-covered ground.



ENCHANTED MESA  
NEW MEXICO  
Surveyed in 1897  
BY GEORGE H. PRADT

Scale 1:100,000

also been so long washed away, and I was forced to take the

testify to the former habitation of the site.

To the town as Kuzhina is still a new town, as I was a new town, and the study of my children the man of science must yet regard it. The

## ELECTRIC STREET RAILWAYS

1807, 15,250 miles of street-car track in the United States, of

by cable, and 143 miles, or 1 per cent, by electric power. The

cars represented 65 per cent and electric cars seven tenths of

by electricity and only seven out of 100 by horses. J. H.

## MOVEMENT—AN ERRATUM

(who alone), they are associated with the wrong titles.

THE HISTORY OF THE UNITED STATES

By CHARLES C. HERRICK, LL. D.,  
President of the National Geographic Society.

MADE BY  
C. C. HERRICK, LL. D.

than that of China and a little less than that of Europe. From  
40 degrees of longitude, or about one third of the earth's sur-  
face. Thus, it is much smaller, surface-wise, than the Middle  
East, 20 minutes before sunset in westernmost Alaska. From  
it stretches northward to northernmost Alaska, more than 300  
miles, or a few feet below sea level in the deserts of southern Cali-  
fornia to heights of more than 10,000 feet in Alaska.

population of a little less than 4,000,000. A century later its  
area was nearly eleven times as great and its population about  
seventeen times as great, or between 65 and 70 millions.

which pointed the way to and stimulated other discoveries. These are at least finished and within the limits of the United States—the tracts still exist which have never been seen by the white man. Of other tracts, though seen and long vaguely known, our knowledge is at a dim and shadowy

For a century after Columbus a navigator was named to our

at of the Pacific coast north of California our maps until about 1780 were either blank or filled with fables, lands of monsters

the general outlines of America as we now know them. The gen-

if not the superior of Cook, whom every American student delights to honor, Capt. George Vancouver

ated the production of maps of the western colonies. The numerous and excellent, for their time, maps by the English,

Georgia, and so much of the interior as was the scene of hostil-

land was conjectural. The existence of the Great Lakes, of the

known

Such was the world's geographical knowledge of what is now the

dividual states, private persons, and corporations.

That they might acquire title to land for their homes, the gov-



ernment early devised a system of land partition. Surveyors of town and range or gift. The land was divided into square and sometimes by artificial marks. A row of such towns ran from an arbitrary base line. Each town was further subdivided

These maps, called town plots, now constitute a vast body of geographical data. For geographical purposes the results are shown in a series of maps of the United States. The Land Office, now a part of the Department of the Interior, has a series of maps of the United States, showing the results of its topographic surveys.

Land Office, now a part of the Department of the Interior

For geographical purposes the results are shown in a series of maps of the United States. The Land Office, now a part of the Department of the Interior, has a series of maps of the United States, showing the results of its topographic surveys.

of the United States.

Chart and Geodetic Survey. - Another old and important ge-

I have been very much interested in the results of the geodetic survey of the United States. The results are shown in a series of maps of the United States, showing the results of its topographic surveys.

day.

From the beginning its aims were high. Great accuracy has ever been and is its motto. It has been a leader or a follower. It has developed its own methods and instruments, and to its officers, civil, military, and naval, we are indebted, among other things, for the fact the compass for the coast and into deter-

mining and the study of the ocean depths.

Its field of work was extended in 1871 to include graduate work in land and ocean, and in 1876 it received the name of Coast and

ocean physics, terrestrial magnetism, and of the size, shape, and structure of our planet.

*Engineers Corps, U. S. A.*—The U. S. Engineers, though not newly prosecuting geographical research, have in the past made valuable contributions to geography. Prior to and even since the war of the rebellion, 1861-65, numerous expeditions in the far

western and southwestern two hundredth surveys have been carried out in the past by the U. S. Engineers. One was a survey of the northern and northwestern lakes, which after an existence of forty years, was completed in 1881. It was a series of detailed and accurate charts of all the Great Lakes and a valuable

put to use in determining certain peculiar changes in the crust

compared with recent ones, is of value for a period of

and Detroit meeting of the American Association for the Advancement of Science by Mr. G. K. Gilbert, of the U. S. Geological Survey.

Another noteworthy geographic work by the U. S. G. S. was a general topographic survey in the far west under the direction of Captain George M. Wheeler, U. S. A., and usually referred to as the Wheeler survey. A considerable tract of country was

surveyed in the years 1872-1876.

The present biological survey in 1893.

The work of improving rivers and harbors in the interest of commerce is now carried on by the United States engineers, and their geographic work consists in special surveys for channel improvements and a new survey of the Great Lakes.

*Geological Survey.*—The chief agency for increasing geographic

knowledge is the Geological Survey, now fifteen years old. Nearly all

The conditions confronting this survey at its creation differed in no important particular from those which it confronts by European geological surveys. These surveys and, in almost if not quite every case, been preceded by topographic surveys, and

maps. Accordingly in 1882 authority was given to make topographic

Survey has received and mapped on a scale of one, two, and four miles to the inch an area of 750,000 square miles, about equal

on the quarter scale, 40 on the two-mile scale, and 80 on the

single area territory. Following these came the geological sur-

systems of rock classes that on our only apply but to a great and

primary work. That has been accomplished, and systematic geological mapping has been in progress for some years.

The aspect of the country and its utility for timber is largely dependant on the annual rainfall. It ranges from a very few inches in the driest part of the land or lower reaches of the mountains, to nearly or quite 8 feet per year on the coast of Southern Alaska. As the land becomes more settled its popu-

lation of the Geological Survey is wisely devoted

primarily to the study of the water supply and the forestry problem. The proper administration of the forests and preservation from destruction by carelessness or greed is a question which attracts serious attention. A number of large forest tracts

with the Yellowstone National Park, the Yosemite, and others

of these forest reserves. This work is under the direction of the United States Geological Survey.

The output of the mines and quarries of the United States has

available a succession of general statistics has existed in the Geological Survey from the beginning, charged with the duty of

volume devoted to general statistics and the state of the mining industry from year to year finds permanent record in these vol-

of information useful to those who go down to the sea to trade.

those of the United States, ocean meteorology, terrestrial mag-

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increase in our knowledge of the geography of the sea.

*Weather Bureau.*—To investigate the history, structure, and

meteorology of the earth's sea-water envelope is the province of the

govern its behavior and the inductive deduction from these laws  
which furnished to them for, the former, the traveler and the

storms. It seeks to be the weather of tomorrow and of then  
that of the last year or the last century. But, as we are forced to

is not neglected, and within the bureau there has ever been a

total of net silt is far wider than we have indicated—so wide, at least, that time will not permit even a mention of it.

Thus have we briefly summarized and characterized the work carried on by the greater geographical agencies of the Government of the United States, and yet such summary would be incomplete without mention of least of several other agencies still at work and actively contributing to a deeper and better knowledge of our geography.

The total number of miles of the United States, not counting several of the lake shores or strips, is estimated at over 1,800,000 miles, or about 45 per cent. of the world's mileage. To locate and construct these thousands of miles of road, much of it in

surveys begun, has involved a vast expenditure of money by which geographical knowledge has been increased. It has been estimated, perhaps it would be more exact to say guessed, that

produced a topographical map of the entire country. The chief

standards. Over all these immense lines of road have been run

those obtained from other sources, it has been possible for the  
of the United States

courses of the Missouri to the passes at the mouth of the Mississippi in the Gulf of Mexico is 4,200 miles. These two great rivers, with their tributaries, afford in number of miles

the artery of commerce that two are not to be mistaken, one for the Mississippi and one for the Missouri have existed for some

940 the sheets. Much precise leveling has also been carried on in connection with these surveys.

eral months, have conducted geological surveys, or perhaps it should be said geological reconnaissance. Two have conducted

such studies, Rhode Island, Connecticut, and New Jersey, as also

reference to the north and in contours with a vertical interval of 50 feet.

The Post Office Department, for its own purposes in administering the postal system under its control, compiles state maps showing post-routes and post-al office locations. The maps are

by correspondence and constitute a valuable source of information as to minor boundaries.

A recent law has been made to the work of the Fish Commission

the gentlemen actually conducting the works contained

achieved is but a small part of what remains to be done. Geographic research and progress in the United States has never

promoting geographic research, and the National Geographic Society of Washington a few years ago entered upon similar work

received and have flowed from our pen.



## THE U. S. COAST AND GEODETIC SURVEY.

By T. C. Mendenhall, LL. D., Ph. D., etc.,

*President of the Worcester Polytechnic Institute, and formerly Superintendent  
of the Coast and Geodetic Survey. Washington, D. C.*

OTTO H. TITMANN,

*Assistant in Charge of the Office of the Survey.*

Although a relatively small part of the energies of the United States Coast and Geodetic Survey has been devoted since the creation of the Bureau in 1807, to geographic exploration, the

From the very start the standard of work has been the highest

condition the Survey has made it its business to better any

of the Government in which exact sciences were cultivated.

And application of science to the solution of certain practical

value to commerce.

laws which carried the wave of commerce to all parts with great

our course. To investigate the tides and currents of the waters  
which bear their precious burden of human lives and property  
to and from, and to study the mysterious variations in direction

was largely directed.

In these immediate preparations the Survey had frescoed itself with vigor and foresight, for the paucity of Hassler and his assistants was more than made up for by the aid of the following:

1. Inert political opinion as to the utility of the proposed survey had to be set to rest, and indeed, men had to be trained to

construct, and correct methods had to be prescribed. How these difficulties presented the motives and how they were overcome will form a proper chapter not only in the history of the Coast Survey, which yet remains to be written, but also in the history of the progress of science in this country.

It is also said that Hassler, in 1844, saw the fruition of his

efforts in the volume. His adoption marked an official recognition of the necessity for precise and systematic work in the mapping of our domain. It set up a standard outline of the operations

the extension of the work in a most conspicuous mode with the enlargement of our national domain by acquisitions of territory from France, Spain, and Mexico. With the expansion of territory came the extension of the scope of our survey, and finally when the advantage of a transcontinental triangulation became apparent, its proper function was recognized by law.

In accordance with its primary duties the Survey has determined and reported the depths of the waters along our coasts with

accuracy, but not shore as far as the needs of commerce or navigation

demanded, as is shown in the completed survey of the Gulf of Mexico.

Long, estimates of the waters were recorded. Much earlier than these

stream, important not alone in their geographic results, but in developing methods, and by facilities which rendered

quant success possible. The hydrographic results achieved are evidence for an early map

Its researches in physical hydrography include not only the measurement of planes of reference from which the constancy of the relation between the ocean level and the land is to be inferred, but it has also labored for it, as in the measurement of energy shoreward, as, for instance, those of Cape Cod and of the exposed shoals of Narragansett Bay. It has been engaged to describe the relation between the varying elevation of the ranges of the shore. Here, again, previous work alone is of a minimal, for correct conclusions can be drawn only after the lapse of time and a full record of conditions has been obtained by an accurate

Work of surface finds the entrance of a new species, results, but the discovery of the value of the total results are through the East river as a factor in maintaining the depth of the great sandy Hook and the discovery of the entrance of the H. plan and its bearing on the feasibility of obtaining a water

the logarithm is an essential for a set of properties

A property belonging to the subject of the hypothesis is not

are invaluable historical records of the progress of that country. The same may be said of the volumes covering the territory for

answer. They are not intended to show, in general, but they

\* = number shown in column (a) by way of

The results of the survey are uplinked by acoustic repre-

Analysis of nuclei at narrow range of logarithmically has been made and

- studies triangulated on, which all tests rest on a larger network of triang. on which record makes a little stronger or 2. is consists

It is a straightforward and precise method for the determination of latitudes and longitudes without the need for a sextant or other operations of the survey. Thus the success of Alcock in the

by former restrictions given by Hansen to Walker to prepare for telegraphic longitude determinations; and it was not until the summer of 1941 that the method was successfully put to a practical test by the exchange of signals between a land station and a ship.

ington, and thereafter the precise determination of longitude

As soon as the Atlantic cable had been laid in 1866, the survey

at New York, Massachusetts, in 1867, was used. The adopted value (1.444 in 5.8) had been derived from many

observations and observations for determination, but this value was increased in 1867 by 1.55 as the result of comparison with

published in 1865, as the result of 285 mean observations, was of the telegraphic determination.

Being for all the astronomical longitudes of the points measured in it, not only in their relation to each other but to the

less need be said of the astronomical determinations, since the

also in the determination of longitudes. On the other hand, however, the zenith telescope, as developed by the survey, has in the hands of its observers considerable material for the knowledge of the accuracy of the work.

Reference has been made to the geodetic survey of the survey.

er boundary to the Gulf of Mexico. To join this with the primary chain, as yet incomplete, of triangles from the Pacific

ation, the completion of which has been recently announced.

The accomplishment of the geodetic survey along this great meridian is also a part of a large system of geodetic measurements which will furnish the foundation data for the construction of a uniform set of State surveys for all time to come, if it be permitted so fallible human wisdom to make such an assertion.

## THE GEOGRAPHICAL WORK OF THE U. S. COAST SURVEY

Original in its inception, splendid in its execution, this monograph

yet, it is hoped will take a hand in its extension southward

unity for its production northwest may be offered in the course of time

defining the boundaries of eleven States, and as has been ex-

along the northeastern boundary, and in the first set, it has

surveys, as well as precise geographic descriptions for the  
British possessions.

early date, and have been continued up to the present time at a

a hydrographic register of magnetic observations, which it has

value to navigators at sea and surveyors on the land. It contains  
remain a mass of reliable information concerning terrestrial  
magnetic phenomena unequalled in extent and importance.

years to the study of terrestrial gravity. For this, which is both

long in use its observers were quick to detect and point out certain errors and hitherto no serious faults concerning con-

struction. Instruments were also improved and modified

visited on most important routes, on several of the highest mountains and on many islands in the arctic regions. No

is within a range in longitude. The results of these operations, together with the measurement of the great arc of unvaried length form a contribution of no ordinary interest to the trop-

## THE UNITED STATES WEATHER SERVICE

By Prof. WILLIS L. MOORE,

*Chief of the U. S. Weather Bureau*

The United States Weather Service has been in existence twenty-seven years. During the past twenty-five years the daily synoptic charts of the service have shown the most complete and almost hourly survey ever presented to the public.

The vast region now brought under the domination of the daily synoptic observations embraces an area extending 2,000 miles north and south, 3,000 miles east and west, and is fortunately located in the interest of the meteorologist as to all an-

important are from the circumference the roughness of shores of the northern hemisphere. The extreme latitude of observation are Johnston, in the Central Province of America on the

east, and San Diego, on the southwest; and arrangements are now complete for a co-operation with Mexico similar to that

area of observation southward over Mexico and Yucatan.

It is a wonderful panoramic picture of atmospheric condi-

lons, which by the aid of such accurate measurements and the

picture of actual conditions is shown. When placed on the meteorologist's table, such opportunity to study storms and their physical changes?

In the outline of the eighteenth century, Franklin's interest in the rotary and progressive motions of storms, early in the nineteenth

century later, Laplace and Ferrel revealed these theories and added much to our knowledge; but at this time when one has been able to satisfactorily explain the forces operative in

the important of cyclonic force that is well understood and accurately computed is the deflection due to the earth's rotation

model of currents to but a slightly higher elevation before reaching

of the environment, and there is no action of the latent heat

of water.

The widely differing elevation, topography, temperature, and humidity of the ocean region under observation give conditions

when they present to the physicist to study the mechanical

can be profitably studied with greatest advantage taken on the bottom of the great aerial ocean surrounding the earth.

Here we see summer cyclones formed near the intense heat

on the cold waste of the Rocky Mountain peaks, cyclones



move eastward to our lakes and thence to the St. Lawrence valley, south on the warmer plains of Colorado, over into the Ohio river, and on; and evanescent which, if they have their position

at an average altitude of 5,000 feet above sea level and under

that surface and then, as they are seen as they reach the ex-

posed islands and cross the Pacific ocean come under our vision

across with but the diminution of energy sweep across our horizon with increasing force and heavy precipitation, and

Atlantic seaboard only to be heard from three days later as ocean swimmers of northern Europe.

The great anticyclones or high pressure ridges, which consist-

charged conditions during 3,500 miles of their course. The

earth for the cold ranges, for a strong vertical and active con-

from above. In the cold wave it must be remembered that the air

atmosphere possesses such intense cold at the elevated level

compression to its descent, it is still far below the normal temperature at the surface of the earth.

investigation

different classes of atmospheric disturbances. From a knowledge

to count the barometer.

Having long been told that, I determined at once, on coming up to

of not less than one mile above the earth, as it appeared to

formation of clouds. It was necessary to improve our methods of forecasting simultaneous observations at a uniform high level

condition of this important investigation. Professor Marvin was

strengthened, and I am pleased to say that we have improved our flying to such an extent that a kite is now easily sent up to a height of one mile in only a moderate wind. We have now an instrument that while we are going loss take two points, i. e., record temperature, pressure, humidity, and wind velocity. Before next spring we expect to have it less

less. A kite was sent flying during day runs at an elevation of one mile or more.

We shall then construct a chart from the high-level readings obtained at these weekly stations and at the same time compare it with the surface chart made at the same moment. Being

of course of the development of storms and cold waves and eventually improve the forecasts of their future course, extent, and rate of development.

In exceptional cases we have flown the kites to a height of nearly two miles, from daily readings at only one kite station.

It is essential to determine the future direction of a cyclonic center when more surface charts give but negative indications. It was found

that if storm eddies turn backward and ascending convective air currents

indicate a rise in the difference in temperature between the surface and the 5,000 feet stratum in the lower atmosphere of the

storm, the storm and cold-wave conditions are intense. At an elevation of five miles but little effect remains of thermal inversion

given clue to the future direction of the storm. When we now

have discovered that the storm center at that elevation was not

center at the surface of the earth. The displacement of this center may possibly give some indication of the future direction of the storm. There are many interesting problems to be solved by this investigation.

The Eleventh International Congress of Chemists was opened at Paris on September 4, with 300 non-foreign attendance. One of the most

interesting was completed by the end of 1913.

## GEOGRAPHIC NOTES

### AFRICA

**RAILROADS.** The first step in the first railroad in British West Africa is now being completed between Freetown and Waterloo.

**RAILROADS IN AFRICA.** A company has been formed to construct and operate a line of railway from London to Salisbury, a distance of about 100 miles. It would be the first one of the existing ones in Africa.

**AGRICULTURE.** A recent report on the crops of Africa states that wheat, which could be grown by irrigation at the rate of a bushel for a penny, is now sold at from 2s. 6d. to 3s. 6d. for 10 bushels. Cotton of good quality grows well in many parts of the continent.

### INTERNAL AFRICA

**RAILROADS.** The report of the government, surveyors on the possibility of a proposed railroad from Beaufort to a western frontier of the colony (a distance of 70 miles) estimates the cost of construction at \$5,575,232, or about \$50,000 per mile. It is also stated that if the road would pay interest on an original investment of less than one cent it would be profitable, and the government is now in a position to build it.

**MINING.** Mr. Thomas O'Hara, U. S. consul at Freetown, reports that there is no gold in the colony, but a silver mine is being worked. It is also being worked by a company of men, and the results are being sent to the government.

The extensive use of water, except in a very few cases for fire, is not due to fear of earthquakes, but to the fact that there is no need of it in the vicinity. There is, however, no market for imported brick.

### SOUTH AFRICA

**MINING.** The government of Transvaal has agreed to 3 years' lease of the mine at Beaufort, at the rate of 100,000, the two copies of which are in the country. The consideration of the establishment of a new mine in Transvaal with a capital of \$1,500,000. The mine will have to be sold to the Transvaal at 100,000, and the amount of 100,000. The mine is reported to have created great dissatisfaction among the people.

**MINING.** A recent writer on the gold industry of British Columbia states that while the colony has a future as a gold-producing country is a question not yet answered from the region of doubt. There

is a great deal of mining in the vicinity of the mine. The total gold produced in the colony for the year ending June 30, 1897, was 12,414 ounces, as against 10,422 ounces in 1896-'97, and 38,270 ounces in 1895-'96.



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A Greater Amount of Assets	-	-	-	(\$235,000,000)
A Larger Annual Interest Income	-	-	-	(\$9,000,000)
Writes More New Business	-	-	-	(\$136,000,000)
And Pays More to Policy-holders	-	-	-	(\$25,000,000 in 1896)

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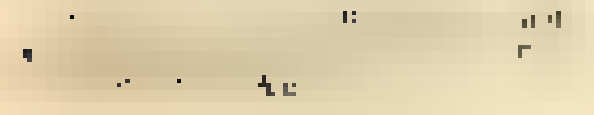
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	SCORE		GAIN		TRUMP		SCORE		
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